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# PATENT SPECIFICATION

(11) 1 336 676

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## DRAWINGS ATTACHED

- (21) Application No. 31873/71 (22) Filed 7 July 1971
- (31) Convention Application No. A6213
- (32) Filed 8 July 1970 in
- (33) Austria (OE)
- (44) Complete Specification published 7 Nov. 1973
- (51) International Classification F16K 15/14
- (52) Index at acceptance  
F2V J2A J2F  
FIN 2G1A1

(19)



## (54) VALVE ARRANGEMENTS PARTICULARLY FOR PISTON COMPRESSORS

(71) We, HOERBIGER VENTILWERKE AKTIENGESELLSCHAFT, of Braunhubergasse 23, 1110 Wien, Austria, an Austrian Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to valve arrangements particularly for piston compressors of the type comprising a flexible valve plate in face to face relation with a valve seat one end of the plate being fixed and its opposite end being free to move away from the seat to allow flow of fluid through a port in the seat, a stop being provided to limit movement of the opposite end of the plate.

In known valves of this kind the plates consist of flat plates or tongues which are clamped on the valve seat plate at one end, while the other end lifts resiliently off the seat for example during a suction stroke of a compressor. The movement of the plate is limited by a projecting portion of the plate at the end which moves, or else at the side of the plate, which portion strikes against a stop disposed for example on the edge of the cylinder or in the cylinder head of the compressor. The outer edge of the projecting plate portion strikes first against the associated stop and rubs on the surface of the latter when deflection of the middle part of the plate and consequently the length of the plate varies. This may result in relatively great wear, and because of the frictional forces produced the free mobility of the plate may also be impaired, so that the stresses applied to the plate are increased.

The present invention provides a valve arrangement comprising a flexible valve plate positioned in face to face relation with a valve seat, one end of the valve plate being fixed to one side of a port in the valve seat and the opposite end of the valve plate being

free to move away from the valve seat to allow flow of fluid through the port, a stop for limiting movement of the valve plate away from the valve seat by interengagement of a surface of the stop with a surface of the valve plate on a side opposite from the said one side of the port wherein at least one said surface is convexly curved in relation to the other said surface.

Said surface of the valve plate is preferably formed on a projecting or nose portion of the plate.

Through this construction the edge of the plate is prevented from striking against the stop surface, so that the edge does not rub into the stop surface. The surfaces striking against one another, at least one of which is curved convexly in relation to the other, will instead roll one on the other after the plate strikes the stops, so that, although the contacting surfaces are displaced in relation to one another, the resulting frictional forces are smaller than in known arrangements.

The projecting nose or portion is preferably bent to provide a convex surface. It may first be bent at its root out of the plane of the plate in the direction of the stop and then extended away from the latter in a curve, which may for example be substantially part-circular, and lies entirely on the side of the plate which faces the stop. The plate can thus lie flat on the sealing surface of the valve seat without an additional recess being required in the seat for the portion bent out of the plane of the plate. Alternatively the plate may be provided with a curved, preferably spherical depression providing a convex surface.

According to another feature of the invention the stop surface may also be convexly curved in place of or additionally to a convex surface being formed on the plate. For example, a curved preferably spherical protuberance may be provided on the stop, which for example may be formed by a rivet head. Another construction of this kind

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consists in providing the stop surface with a cutout, for example a groove, with a rounded flank. In both cases it is not necessary for the plate surface to be curved. However, both the surfaces striking one

Examples of valve arrangements according to the invention are illustrated in the accompanying drawings in which:

Figure 1 is an axial section through a valve arrangement according to the invention in a piston compressor;

Figure 2 is an inverted plan view of the arrangement shown in Figure 1,

Figures 3 and 4 show the plate ends for two different forms of construction of plate, in side elevation, and

Figures 5 and 6 each show in diagrammatical section a detail of alternative forms of stops.

The compressor illustrated in Figure 1 consists of a cylinder 1 with a cylinder bore 2 and a cylinder head 3, which is provided with a suction chamber 4 and a pressure chamber 5. Between the cylinder 1 and the cylinder head 3 a valve seat plate 8 is clamped, with the interposition of seals 6 and 7, and is provided with two suction ports 9 and one pressure port 10. On the upper side of the seat plate 8 there is disposed in the pressure chamber 5, a pressure valve which consists of a pressure plate 11 and a stop 12 which is fastened by means of a pin 13 onto the seat plate 8. On the under side of the seat plate 8 there is disposed a flexible suction valve plate 14, which at one end is clamped between the cylinder 1 or the seal 6 and the seat plate 8, while its other end is free to move to control fluid flow through the suction ports 9. As can be seen particularly from Figure 2, the suction plate 14 is provided at its free end with a projecting nose 15, which is associated with a stop 17, which may for example be a recess 16 cut out of the cylinder 1 and which limits the movement of the suction plate 14 during opening movement of the latter.

Of the two surfaces on the nose 15 and stop 17 which strike against one another for the purpose of limiting the stroke, at least one is curved convexly in relation to the other. In the construction illustrated in Figure 3 the nose portion 15 is first bent at its root out of the plane of the suction plate 14 in the downward direction, towards the stop 17, and then runs in an approximately part-circular arc upwards away from the stop 17. In accordance with Figure 4 on the other hand the nose portion 15 is provided with an approximately spherical depression 18, which is likewise curved downwardly out of the plate 14, in the direction of the stop 17, and can for example be produced by indentation. In both cases, the curvature of the nose 15 lies entirely on the side of the

plate 14 which faces the stop 17, so that the plate can lie tightly against the flat underside of the seat plate 8. It would however also be possible for the nose 15 to be bent entirely or partially upwards away from the stop 17, in which case a recess would be required in the sealing surface of the seat plate 18 to receive the nose portion 15, in order to enable the plate 14 to seal the suction ports 9.

The convexly curved construction of the nose portion 15 of the plate 14, as illustrated in Figures 3 and 4, has the object of preventing the outer edge of portion 15 from striking against the stop 17 and rubbing on the stop surface. Even when the stop 17 has a flat surface, as shown in Figure 1, the convexly curved nose portion 15 strikes against the stop 17 with its curved surface, and when the plate 14 deflects further the curved surface rolls on the stop 17, and although it also slides slightly on the latter it cannot penetrate into the stop because of the curved surface. Practically the same effect is achieved if the stop surface is convexly curved, in which case the nose portion 15 may be flat. Examples of this kind of construction are illustrated in Figures 5 and 6.

In Figure 5 the stop 17 has a curved protuberance 19, which is formed by the head 20 of a rivet 21 which is inserted into a bore provided in the stop 17. In the arrangement shown in Figure 6 a groove-like cutout 22, the flank 23 of which is rounded, is provided in the stop surface 17. In these embodiments the edge of the nose portion 15 of the plate 14 does not strike against the stop surface 17, even if the nose portion 15 is in the same plane as the plate 14, as shown in Figures 5 and 6, in which plates 14 having flat nose portions 15 are shown in broken lines. It is however also possible to use plates having convexly curved nose portions in conjunction with the convexly curved stop surfaces shown in Figures 5 and 6.

The arrangement according to the invention, which provides for the convexly curved construction of at least one of the two surfaces striking against one another for limiting the movement of the plate, can be applied not only to the suction valve of a piston compressor as illustrated, but also with equal advantage to the pressure valve, if the latter is provided with a plate clamped at one end. In addition the invention covers all possible plan shapes of the plates, in particular constructions having a plurality of stroke limiting nose portions cooperating with stops.

#### WHAT WE CLAIM IS:—

1. A valve arrangement comprising a flexible valve plate positioned in face to face relation with a valve seat, one end of the

valve plate being fixed to one side of a port in the valve seat and the opposite end of the valve plate being free to move away from the valve seat to allow flow of fluid through the port, a stop for limiting movement of the valve plate away from the valve seat by interengagement of a surface of the stop with a surface of the valve plate on a side opposite from the said one side of the port wherein at least one said surface is convexly curved in relation to the other said surface.

2. A valve arrangement as claimed in claim 1 wherein said surface of the valve plate is formed on a projecting portion of the valve plate.

3. A valve arrangement as claimed in claim 2 wherein said surface of the valve plate is convexly curved in relation to said surface of the stop, said projecting portion of the valve plate being bent to provide said surface of the valve plate.

4. An arrangement as claimed in claim 3 wherein said portion of the valve plate is bent substantially in a part-circular curve.

5. An arrangement as claimed in claim 3 or claim 4 wherein said projecting portion of the valve plate is bent to lie entirely to one side of a plane containing a main body portion of the plate.

6. An arrangement as claimed in claim 1 or 2 wherein said surface of the valve plate is

convexly curved in relation to said surface of the stop the valve plate having a depression providing said surface.

7. An arrangement as claimed in claim 6 wherein said depression is part-spherical.

8. An arrangement as claimed in any preceding claim wherein said surface of the stop is convexly curved in relation to said surface of the valve plate, said surface of the stop being provided by a rivet head.

9. An arrangement as claimed in any of claims 1 to 7 wherein said surface of the stop is convexly curved in relation to said surface of the plate said surface being formed as a projection from an adjacent substantially flat surface.

10. A piston compressor having a valve arrangement as claimed in any of the preceding claims for controlling flow of fluid into a cylinder of the compressor.

11. A compressor as claimed in claim 10 wherein the stop comprises a recess formed in a wall of the cylinder.

12. Valve arrangements substantially as herein described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1973.  
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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## COMPLETE SPECIFICATION

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*This drawing is a reproduction of  
the Original on a reduced scale*

FIG. 1

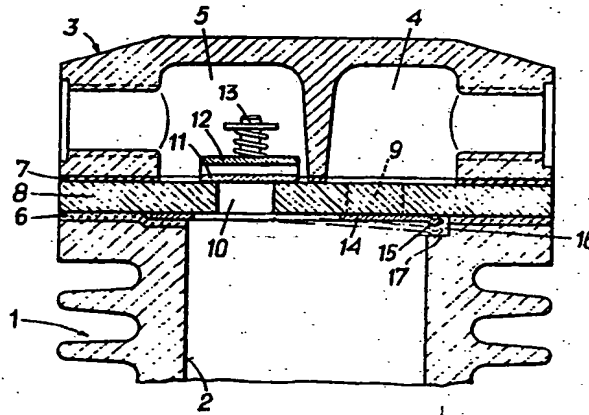


FIG. 2

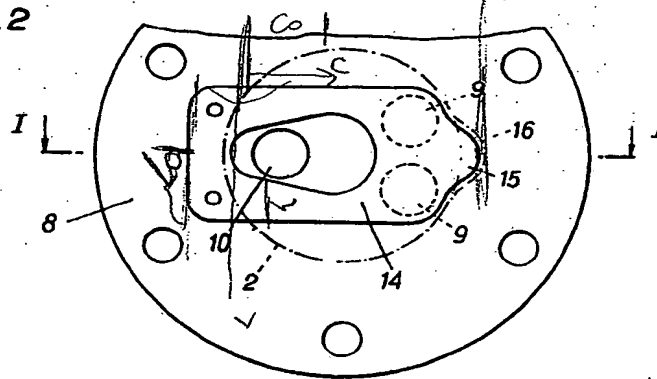


FIG. 3

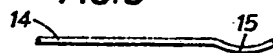


FIG. 4

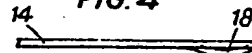


FIG. 5

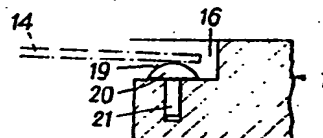
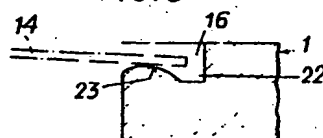


FIG. 6



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